1996-12

Advanced material presentation : a study in technology and ergonomics

Hougen, Terje M.

Monterey, California. Naval Postgraduate School

NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

ADVANCED MATERIAL PRESENTATION: A STUDY IN TECHNOLOGY AND ERGONOMICS

by

Terje M. Hougen

March, 1998

Thesis Advisor: Douglas E. Brinkley
Co-Advisor: Frank Barrett

Approved for public release; distribution is unlimited

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	March 1998	Masterís Thesis

4. TITLE AND SUBTITLE
Advanced Material Presentation: A study in technology and ergonomics

5. FUNDING NUMBERS

6. AUTHOR(S)
Hougen, Terje M.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Postgraduate School
Monterey, CA 93943-5000

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(maximum 200 words)*

Governments and local school systems continue to invest millions of dollars into educational technology. Most of these investments have not produced as promised and some are complete failures. The purpose of this thesis is to determine the state-of-the-art for the implementation of educational technology into the classroom and create a set of common lessons learned from these experiences. Also, an experiment using Microsoft Powerpoint is used to determine students specific likes and dislikes on the infusion of technology into their classroom. Two sections of the same class are used for the experiment. One is a control group that has the lecture material presented to them in the traditional manner (overhead transparencies and blackboard) and the second receive the same material plus additional information made possible by the abilities of Powerpoint. The students are then given a three part survey to express their feelings on the use of presentation technology. Overwhelmingly, the students prefer the use of presentation technology. They feel that the use of technology increases their ability to learn and adds flexibility for the professor and students. Also, the decreased time the instructor must spend writing notes on the blackboard is beneficial.

14. SUBJECT TERMS	15. NUMBER OF PAGES
Information Technology, Education,	66
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFI- CATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

NSN 7540-01-280-5500 Standard Form 298 (Rev. 2-89)

Approved for public release; distribution is unlimited

ADVANCED MATERIAL PRESENTATION: A STUDY IN TECHNOLOGY AND ERGONOMICS

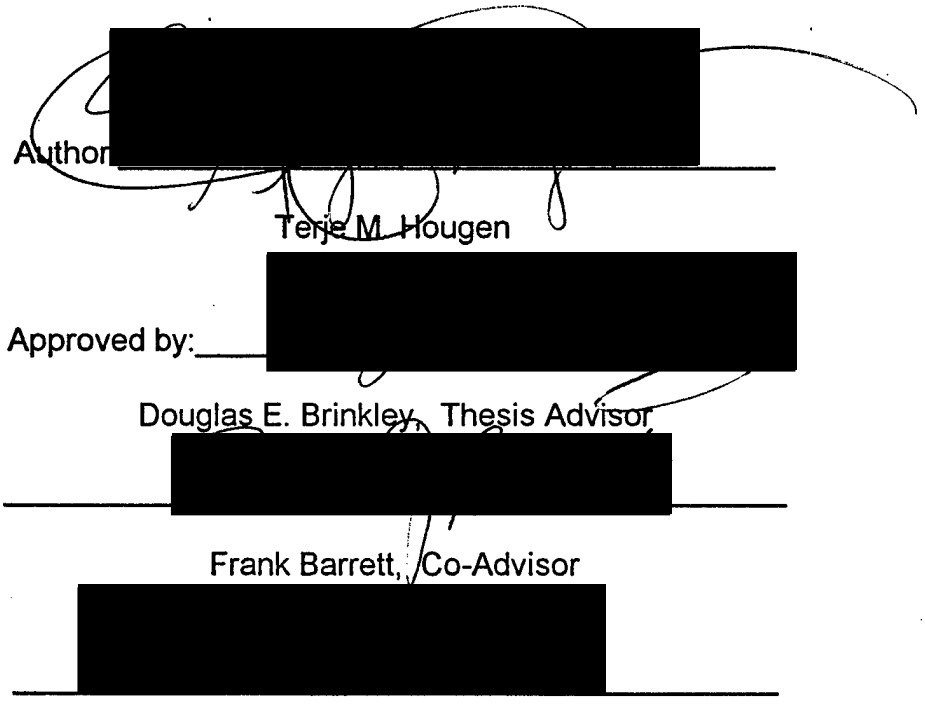
Terje M. Hougen
Lieutenant, United States Navy
B.S., Southern Illinois University, 1995

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
March, 1998



Reuben Harris, Chairman, Department of Systems Management

ABSTRACT

Governments and local school systems continue to invest millions of dollars into educational technology. Most of these investments have not produced as promised and some are complete failures. The purpose of this thesis is to determine the state-of-the-art for the implementation of educational technology into the classroom and create a set of common lessons learned from these experiences. Also, an experiment using Microsoft Powerpoint is used to determine students specific likes and dislikes on the infusion of technology into their classroom. Two sections of the same class are used for the experiment. One is a control group that has the lecture material presented to them in the traditional manner (overhead transparencies and blackboard) and the second receive the same material plus additional information made possible by the abilities of Powerpoint. The students are then given a three part survey to express their feelings on the use of presentation technology. Overwhelmingly, the students prefer the use of presentation technology. They feel that the use of technology increases their ability to learn and adds flexibility for the professor and students. Also, the decreased time the instructor must spend writing notes on the blackboard is beneficial.

TABLE OF CONTENTS

I. INTRODUCTION

This study in advanced material presentation was undertaken to: (1) review the state-of-the-art for integrating technology into the classroom; (2) develop a common set of lessons learned from these integrations; and (3) conduct of an advanced material experiment.

The method of research for this thesis was a review of literature dealing with the infusion of technology into the classroom. This review provided the important background necessary for formulating the lessons learned and the creation of the experiment. It also clarified some specific rules for creating presentations with presentation software. The lessons learned will help future institutions more effectively and efficiently integrate technology into their classrooms.

The advanced material presentation experiment was created as a proof of concept. The concepts to be proven or disproven are: (1) that students like the use of educational technology in the classroom and become better learners when information technology is used; and (2) these technologies can decrease the instructors' workload and increase their students' ability to learn. Instructors received a prepared presentation to give to one of their class sections using Microsoft Powerpoint. The other section of the same class would be used as a control group, receiving the same lecture given in the traditional method (overhead transparencies and blackboard).

Class members in each section were asked to complete a survey describing their feelings on the use of technology in the classroom. For example, they were asked what they like and dislike about the use of technology in the classroom and what items of technology, if any, they would like to see provided for their use.

The first chapter of this thesis discusses the more-than-30-year history of computer-assisted learning—from the beginning, when computers were of the mainframe type and available only to institutions of higher education because of their high cost, to

The first chapter of this thesis discusses the more-than-30-year history of computer-assisted learning—from the beginning, when computers were of the mainframe type and available only to institutions of higher education because of their high cost, to the integration of desktop machines into public school systems. Also, we trace how educational technology, 30 years ago, consisted of nothing more than simple numerical manipulation applications. Today, educational technology encompasses all types of learning, from software applications designed to help preschoolers learn their ABCs, to sophisticated mathematical modeling applications that help college students better understand the mathematical concepts they are learning. Educational technology has also grown from being a scholastic priority to a national and political one. In the last five years, both Congress and the President have signed legislation aimed at increasing the level of educational technology used in the nation's schools, thereby enhancing children's ability to learn.

Chapter II explores some examples of how educational technology has not blossomed as anticipated. Despite the large amount of funds that have gone to support the integration of these new and exciting technologies, there have been many failures. Conversely, some examples of successes are also listed. In these success stories lie common threads. These commonalities, which may help lay the foundation for more successful integration and use of educational technology, are discussed in the chapter.

Chapter III deals with examples of technologies that are specific to the experiment and how they have been received by other institutions. In addition, a guide has been developed which will give instructors the basic rules to follow when using software to help create these advanced presentations. Finally, the chapter describes the methodology of the experiment, including the experiment's objectives and a description of the survey used to gather the student data.

The fourth, and final, chapter presents the questions that were asked of the students, their responses, as well as an analysis of the students' responses to each question. Based on the survey answers, this chapter states some conclusions about students' feelings towards the infusion of information technology into the classroom. These conclusions will provide institutions with useful feedback from the receivers on which aspects of technology they like and which they dislike. Institutions can use this information to choose only those technologies that have been proven effective and listed as desirable by the students. Thus, they will escape the trap of spending large sums of money on technologies that are unwanted and ineffective in helping students learn.

II. HISTORY

"We have now reached the stage when virtually anything we want to do in the field of communications is possible: the constraints are no longer technical, but economic, legal or political." *–Author C. Clarke*

"Education is not preparation for life, it is life itself." *–John Dewey*

A. COMPUTER-BASED LEARNING

It has been more than 30 years since computers were first used for instructional purposes. Since that time, incredible advances in computers, and in technology as a whole, have been made. In the 1960s and 1970s, computer-based learning was restricted to large mainframe computers and was available only at higher-learning institutions. Capabilities consisted mostly of text input and printing. The mainframes were slow, compared with today's systems, and the interface was difficult to learn.

In the beginning, there was a great deal of excitement about the potential of instructional computing. However, despite the great strides in technology and the accessibility of information, actual improvement in learning has been less dramatic and harder to measure. With the introduction of the microcomputer in the late 1970s, the proliferation and use of computers have exploded. Machines have evolved from those with very limited capabilities to ones with that is orders of magnitude greater. They are easier to use, can be networked together to share information, and have very advanced visual and auditory capabilities. At the current level of computer-based learning, although we use a variety of platforms, there is a shortage of people to design and build high-quality courseware. There is also general disagreement among educators on how computers should be integrated into the learning process.

Taylor (1980) was one of the first to try to organize the ideas of computer-based learning. He classified computers by one of three categories: tool, tutor or tutee. As a

tool, the computer is used by the students and teachers alike—for word processing, for example--to aid in the learning process and facilitate academic work. As a tutor, the computer is responsible for the presentation of the material. And when the computer is the tutee, the student teaches the computer--by writing a program, for example--and learns by doing.

Certainly one of the largest problems with computer-based learning is that computers are challenging traditional teaching methods, thereby affecting the roles of teachers. For example, math teachers used to [still?] worry about the use of hand-held calculators in the classroom and their effect on children's learning of basic arithmetic. English teachers now wonder, no doubt, about the use of spell-checking and grammar-checking software when students write reports and essays. More and more, teachers have to deal with complicated and controversial ideas about how these and other skills will be taught. It could be argued that the computer's ability to perform these functions automatically eliminates the students motivation to learn the basic skills necessary to perform the functions themselves (Alessi & Trollip, 1991).

B. GETTING TECHNOLOGY INTO THE CLASSROOM

In 1994, public schools spent approximately $3 billion to purchase educational technology. Additional money was spent on video equipment and the necessary infrastructure and training of school employees. President Clinton, Vice- President Gore and Secretary of Education Riley have called for schools to be connected to the national information infrastructure (NII) by the year 2000. New federal legislation, the Educate America Act, for example, makes educational technology a key issue. The Improving America's Schools Act (IASA) makes prominent mention of technology and requires the Department of Education to prepare a nation-wide plan to promote the use of technology.

A revolution in education, induced by the extraordinary advances in technology, may be underway (Glennan & Melmed, 1996).

Policy makers and the public often pose questions about the effectiveness and cost of technology in schools, often implying that the technology is, in itself, an educational activity. This is incorrect. Technology in the schools, as in the business community, is a means to an end with endless possibilities. A computer can serve as a freestanding unit or be networked to other computers to provide a level of connectivity never seen before. It can serve as a word processor or support desktop publishing for student projects. Email and video-teleconferencing can support communication between parents and teachers, as well as between students. The possible implementations are almost infinite. Because of the diverse nature of technology and its applications, it is nearly impossible to evaluate the effect of technology, as a whole, on education. Therefore, we must focus our effectiveness studies on particular applications of technology.

C. TECHNOLOGY'S VALUE IN THE CLASSROOM

For over 30 years, there have been efforts to introduce technology into the classroom. In the 1960s and 1970s, an effort was launched to introduce educational television into the nation's classrooms. While there is little evidence to suggest that educational technology in the classroom improved teaching, few teachers today would deny the value of having access to television and a VCR. Although television and VCRs haven't fundamentally changed the classrooms, they have brought new resources to sparsely populated and remote areas.

The first large-scale use of computers in the classroom was in support of individual learning activities, such as drill and memorization exercises. As these tools became more sophisticated, they came to include extensive instructional management

features that helped guide students through expansive bodies of material. Modern versions of this technology, known as Integrated Learning Systems (ILS), are found in roughly 30 percent of the nation's schools. ILS are also used in programs for the educationally disadvantaged and for remedial instruction.

The use of these large educational systems would often span many years of a student's education and were originally packaged with the associated software, hardware and networking components. Because of their high initial costs, approximately $30,000, these systems were usually available only to more affluent school districts (Glennan & Melmed, 1996).

There are many similarities between these systems and the ones introduced into corporate America in the late 1960s and early 1970s. While they offered great potential for delivering services to workers or students, they were very expensive and very rigid by today's standards. However, when these machines were linked to one another, email began to replace inter- and intra-office memos. Soon, the internet emerged and connected servers and clients in distant locations. Decentralized computing integrated with effective network software and vastly enhanced the ability of "front line" workers to acquire and use information. This new level of connectivity enabled large scale restructuring of the workplace, which was not only possible but desirable in the name of effectiveness and efficiency.

The same qualities of computing and telecommunications equipment that made it possible to restructure the workplace now make it possible to restructure and reengineer the classroom. Technology has given students and teachers the power to perform many traditional tasks with a speed and quality that were unattainable in the past. Technology allows students and teachers to work individually or collaboratively. Connection to the internet provides access to fellow teachers and students, as well as to the vast stores of information that are increasingly being made available on-line. Technology provides the

possibility for a massive shift in the ways students, teachers and administrators use their time. Technology is no longer a few well-developed tools that can be introduced more or less intact into schools, but a plethora of new capabilities that can serve the ends of teaching and learning (Glennan & Melmed, 1996).

In the 1980s and 1990s, much of the discussion about information technology in the schools has focused on how the technology could be woven into the existing fabric of schools. From both a political and a business point of view, this may be a plausible stance. If the task is to sell computers to schools or to persuade teachers to use them, then it is sensible to try to make them fit into schools as they are now. If, however, the task is to use information technology to renovate schools, then the disintegrative aspect of the technology becomes the focus. Information technology becomes a means for disrupting existing practices and creating a new way of schooling rather than becoming an accouterment to the existing practices. Schools, no less than other agencies and more than many, need to take advantage of information technology. The essence of the issue for schools is this: If anything is possible, what should we make probable in schools? What should be done to make the immense capability of information technology a means for improving the lives of our children and for enabling them to live productive and satisfying lives in an increasingly complex and changing world? (Bosco, 1995).

D. CURRENT USE OF TECHNOLOGY

Technology, as we have discussed, is penetrating the nation's schools. The picture that emerges shows a fairly rapid increase in school technology, but still-limited access by the average student. Over the last 12 years, the growth of computers in schools has been promoted by decreased costs, improvements in software quality, and parents' beliefs that the ability to use technology is another basic skill that schools should provide their children.

The current data suggest that schools are making significant progress in acquiring technological capacity. However, these data can be misleading. By measuring simply the number of computers in the schools, we overlook something very important. How old is this technology? At the beginning of the 1993-1994 school year, almost half of the computers in use were early model Apple and IBM computers. Many of these computers do not have a large enough hard drive to store the latest software; nor can they be connected to the internet. Although these computers still provide keyboard practice and can run older drill-and-practice software, they cannot run current generation software (Bosco, 1995).

1. How Students Use Computers

According to Becker (1994), the use of computers in high schools directly supports the acquisition of skills necessary for completing high school work and acquiring a higher education. Roughly 63 percent of student computer use is directed toward computer education and vocational subjects, and only 31 percent is directed toward the support of academic subjects. In elementary schools, not surprisingly, academic subjects account for the larger portion of use.

Student use of computers in schools is difficult to tailor. Instructors are not always sure which programs are most appropriate for educating students and preparing them for adult jobs. Most software on the market has been described as "long on entertainment and short on content." While this may be the case now, we can look forward to becoming more sophisticated in our use of educational technology and demanding better products from software vendors. Efforts such as this are already underway in some states. It is important for schools to purchase *only* software that has been proven effective in improving learning. We need to push the responsibility for conducting this type of research onto the software producers. We can do this only by limiting our software purchases to those that have been proven to work.

E. CONCLUSION

This chapter has described how technology began to be infused into the educational system. The chapter illustrates how much excitement educational technology has created in the field of education. We have seen enormous growth since modern technology's beginnings in the late 1960s. From mainframe computers performing simple numerical tasks in large computer rooms, we've progressed to the current level of classroom workstations that are able to run sophisticated learning software.

Using case studies, the next chapter will examine examples of educational technology's triumphs and defeats. The chapter also will list specific benefits that educational technology has brought to the classroom and focus on some common success factors in each of these case studies.

III. SUCCESSES AND FAILURES OF EDUCATIONAL TECHNOLOGY

A. IS OUR INVESTMENT PAYING OFF?

As the investment in Information Technology in schools continues to increase, it is important to step back and take stock of what we are getting for our money and to determine if we are achieving the results we expected. Educational technology is riding an unprecedented wave of public support--and spending. President Clinton has made the investment in technology in schools a national priority. In an era which has seen cutbacks in many areas of school funding, ed tech spending has continued to climb steadily; some estimates project instructional technology expenditures to reach $6.46 billion by the end of the century.

Despite this aggressive attitude, some are beginning to question the academic return we are getting for our ed tech investment. Does technology make students better learners? While some studies have demonstrated the effectiveness of individual programs, the more general picture is disappointing. With this in mind, the article by Kneckelbine (1997) sheds some light on our current state of affairs.

Consider the following findings:

- In 1995, the *Detroit Free Press* reported that Michigan Educational Assessment scores in the Romulus, Michigan school district dropped to rank near the bottom of metro Detroit districts. The decline came after a three-year, $24 million investment in computerized integrated learning systems.
- A 1996 analysis of Texas Assessment of Academic Skills scores by the Institute of Academic Excellence showed that student/computer ratio had no impact on the exam pass rates.
- States classified by Quality Education Data as having a low investment in educational technology actually outperformed high-investing states in reading

and math tests conducted by the National Assessment of Educational Progress.

- A 1997 study assessing the impact of a three-year, $14 million technology investment by five New York counties found that schools with more instructional technology increased the number of students taking and passing the state Regents exam in math by only 7.5 percent and in English by only 8.8 percent. According to the study, decreasing the student/computer ratio to 9:1 "did not turn out to be significantly associated with achievement in other topics or grades."
- Already, these studies are causing some to question the wisdom of our massive investment in educational technology. Major articles in the *New York Times, The Atlantic Monthly* and the *San Jose Mercury News* have recently appeared, very critical of ed tech spending and casting doubt on the results this investment has produced. In the midst of the current euphoria over educational technology, we are witnessing the beginnings of a backlash.

In general, computers have so far had only a lackluster impact on student achievement. If we don't want to see the plug pulled entirely, what is needed is a far more critical and discerning attitude toward computer-based instruction. In truth, educational technology is not some sort of homogeneous commodity that must either be bought wholesale or rejected outright. There are thousands of programs available to schools. Some have been thoroughly researched and are undeniably effective at improving learning; others are dreadful time-wasters that are long on entertainment and short on education (Kneckelbine, 1997).

B. IMPROVING THE SOFTWARE

It is the responsibility of educational software publishers to produce products that really do improve student learning and to document this effectiveness up front. To this end, classroom testing and careful effectiveness measurement need to be an integral part of their product development. Many companies have indeed done this research, but even more need to follow suit.

Beyond that, it is the responsibility of educators to *demand* these sorts of results: effectiveness data should be as important as interface and ease of use when purchasing decisions are made. Many state funding and adoption authorities are already requiring effectiveness documentation from publishers who seek to get their software on approved product lists. Georgia's Reading First program has thrown out the challenge to all curriculum material publishers. A recent issue of a Georgia Department of Education newsletter advises educators to "refuse to buy reading material that has not been proven to work." Only when demonstrated effectiveness in improving student learning becomes the central criterion for selection of ed tech products will schools begin to reap the true promise of educational technology.

As Kneckelbine's (1997) article clearly shows, there is a growing problem in educational technology. Large investments have been made into educational technology, and we have no proof that the investment is paying any dividends. Educators were promised that students would learn more in less time and retain more material with the use of this new technology. We can see now that this was not what happened. In some instances, the students did worse with the technology, as we can see from the results in the Romulus, Michigan case.

C. SUCCESS STORIES

In 1990, Joe Wyatt of Vanderbilt University challenged educators to see if they could find information on success stories about the use of educational technology. The

commission sent out 3,200 packets to presidents and CEOs of accredited U.S. and Canadian universities listed in the Peterson's guide. The packets requested institutions to nominate success stories in the use of information technology that improved undergraduate education, thereby validating the investment in ed tech and its benefits to education.

Below are a sample of some of the success stories. At the end of each case study, the submitting institution described critical success factors. These critical factors are important if we are to begin reaping dividends from our investment in educational technology. In addition, it is imperative to find a commonality of factors. All too often, projects are begun without looking to other institutions to see if any "lessons learned" exist. Much effort and money could be saved if we made this simple act one of the first we do when embarking on any large project.

Following each case study is a list of the factors considered critical to the success or failure of project. Then, each of the common factors is analyzed to determine why it is so important.

1. Center of Emphasis: Columbia State Community College

The Center of Emphasis at Columbia State Community College, which develops interactive video and computer-assisted instruction programs, was instituted in 1986. The center is unique at this time because it develops the programs in-house in conjunction with the faculty at the college's media production facility. This allows the software to be tailored to the specific requirements of each faculty and the college (Stropes, 1992).

The faculty do not need technical knowledge to create these programs. The media staff members encourage and assist the faculty with the creation of their interactive programs, if necessary. These programs are made available to students in open labs located on and off campus to supplement the traditional instruction.

Students use the media center to complement instruction in the following disciplines: Human Anatomy, Nursing, Art, Economics, Remedial and Developmental Studies, Data Processing, Radiologic Technology, Secretarial Science, Respiratory Care, Animal Hospital Technology and Engineering Technology. Also, after completing the computer-assisted programs, the students evaluate them so that they may be modified and improved if necessary.

There are 41 Computer-Assisted Instruction workstations and 31 Interactive Video workstations for the students to use, and they are networked together. This is done to allow student access to all instructional programs, regardless of where the program is stored, and the software has been programmed to track student use and progress. Also, the programs can be used to record exam scores and the biographical data of each student who uses them.

a. Benefits

Students currently use more than 290 developed and acquired interactive video and CAI instructional programs to supplement their classroom work. By using interdisciplinary programs that combine similar concepts into a single presentation, students report that their overall comprehension of material has improved.

The Center of Emphasis has continued to expand its program development and delivery to more fields and has provided CAI programs to train area employees at their work sites. Students' easy access to the Center enables them to study required course content as many times as necessary to master the material.

Students evaluate programs by filling out a questionnaire on each interactive video and CAI program that they used. Studies have compared the performance of students who use the Center with that of students who rely only on traditional classroom instruction. Overall, students who used computer-assisted methods reported better understanding and retention of the course material.

b. Success Factors

The staff who created this project listed the following three critical success factors: (1) adequate funding to allow the creation of the software; (2) willingness of faculty members to become content specialists and to accept the idea that their participation in this type of alternative learning would enhance students' performance; and (3) funding commitment from the senior administrators and human resources support (Stropes, 1992).

2. Community College of Maine--A Statewide Associate Degree Program

In 1989, CCM began transmission of 36 courses to more than 2,500 students in 47 locations across the state. This has grown to over 40 college classes available in 84 sites, with an enrollment of over 4,000. Students also have access, via on-line service, to the college's library catalog (MacBrayne, 1992).

The Community College of Maine has created an expansive distance learning program designed to offer educational opportunity to Maine's citizens. For many years, people living in rural portions Maine have been denied easy access to higher education because of their geographic location, cost of tuition, and the time necessary to travel to a college campus. Now, from all parts of the state, people have an opportunity to update job skills, earn a degree, and meet with business and state leaders in CCM's electronic classrooms.

CCM has created an Interactive Television System that harnesses the new and powerful technology of distance learning. The program allows people who once were disenfranchised from higher education simply because of their distance from a college campus to take college classes. Student evaluations show that the program has succeeded. Students who were an average of over 32 miles from the nearest University of Maine System campus now are an average of only ten miles away from a distance

classroom. CCM offers associate's degrees in general studies, early childhood education, business, and social services. In addition, baccalaureate degrees and high-school classes are also offered.

The cost of development, in the first year, was $2.2 million. A portion of these funds went toward creating the infrastructure that, among other things, included the Instructional Television System, a point-to-point microwave and a fibre-optic telecommunications system (MacBrayne, 1992).

a. Benefits

The most important and obvious benefit of this program is increased educational access for the citizens of Maine. Opening the doors of higher education to people who, because of geographic location, would not otherwise have an opportunity to attend remains the most compelling reason to implement programs of this type.

Of course, the program has other benefits, as well. The faculty's efforts to produce courses that are effective and stimulating for distance learning students have resulted in better-organized and more innovative courses for all students. Many of the faculty are coming together across disciplines to team-teach courses. Support services are enhanced for students both on and off campus, as they become restructured for optimal availability and convenience. Computer literacy has become an important side benefit for the students who engage in computer conferencing. Furthermore, collaboration has increased among campuses, thus creating a smoother-running and more responsive university system for everyone.

Faculty and students complete an evaluation of CCM's program every semester. Student evaluate the ITV system and [its effect on their?] academic performance, while faculty members comment on their own teaching experience and on the system as a whole. So far, their responses have been quite favorable, and their suggestions continue to refine the system.

b. Success Factors

In this case, the cost of development, while high, is no higher than the investment made in failing systems. Why did this one succeed? The critical success factors that were listed include: (1) the technologies used addressed a specific and identified existing need; (2) the project had the support of both the senior administration and the state government; and (3) the faculty and staff were committed to bringing this type of technology into the educational system (MacBrayne, 1992).

3. CAI to Enhance Human Interaction in Learning Deductive Proof Construction--University of North Carolina at Charlotte

This project supplements a university-wide general education course in Deductive Logic. Since this project is tailored to satisfy a general education course requirement, the students involved have a multitude of backgrounds. The heart of this course is proof construction and is usually what gives students the most problems. Since such a diverse range of students take the course, it is important to determine what specific difficulties students are having mastering the process of proof construction so that class time can to be tailored to solving these problems (Croy, 1992).

To address this dilemma, two computer-assisted instruction programs were written--Justified Thought and Deep Thought. The initial intent of these programs was to give the students unlimited practice with immediate feedback and positive reinforcement. However, this did not work because the students' ability to grasp the concepts involved varied so greatly.

So, the programs were modified to be sources of data collection. These data were then used to determine where students were having their difficulties. As the students used the programs, records were kept on rule application success rates, errors, and the steps the students took to solve proof problems.

Implementing this type of data collection has had three primary effects. First, by periodically generating class reports, it is now possible to tailor in-class instruction to resolving the problems that the majority of the students encountered. Second, at the end of each semester, the results of each class are put to statistical analysis to try and determine common problems. And third, a feedback loop is created. The CAI programs are then modified using these statistical data in an effort to improve the programs and, subsequently, enhance the learning of these difficult processes. Instructors not only can tailor their in-class presentations, but they also can meet with students individually to discuss their personal difficulties (Croy, 1992).

This project provides an excellent example of how database technology can be used to enhance learning. The cost for implementing this technology was less than $10,000. This is a small investment, especially when compared to some others, that is reaping large dividends.

a. Benefits

The project's benefits grow out of the discoveries made concerning the students' needs, improved in-class instruction, and enhanced human interaction between instructor and students. First, there is evidence that something has been learned about the components of proof construction that are usually the most difficult for students. The set of pseudo rules (patterns of rule misapplication) that have been identified accounts for almost half of all the rule application errors made. The program was constructed around the concept of pseudo rules, and rule application success rates showed an immediate improvement the semester it was introduced. Compared with those from the previous semester, success rates improved from 78 percent to 82 percent. Also, a controlled study that compared the use of this program with identical exercises completed as homework assignments demonstrated that students who used CAI subsequently made fewer mistakes with more difficult rules and took less time to construct the proofs. Further

categorization for the most difficult types of rules has stood up across problem sets from four different logic textbooks.

b. Success factors

The critical success factors listed by the faculty involved with the project were: (1) the supportive environment of the senior administration, and (2) the faculty's belief that they were incorporating technology that would directly improve their teaching and the students' ability to master a difficult process (Croy, 1992).

4. Interdisciplinary Electronic Classroom--Vanderbilt University

Vanderbilt University developed its Interdisciplinary Classroom in 1989 so that faculty and students could use and work with advanced computer tools. The majority of the project work focuses on developing and determining which courses can be improved through the use of educational technology. The project addressed a number of questions, including: How can educational technology be used to improve a course and make the presentation of course material stronger? Can more material be taught in the same amount of time? Do students retain more if the material is presented in this manner? Does this method of teaching increase the students' depth of understanding? The electronic classroom is outfitted with 31 workstations, as well as an instructor's podium that can control various pieces of audio-visual equipment. Each workstation runs a variety of software applications--spreadsheets, word processing, Mathematica (a mathematics program), statistical software, etc. The instructor's podium has a similar setup with a built-in computer that can control a slide projector, videotape players in both Beta and VHS, laser-disk, CD-ROM, digital audio tape deck, cassette player, and a three-dimensional RGB projector. In addition, all of the workstations are networked together using Ethernet, and there are two laser printers at the back of the classroom that can be used to print documents from any workstation (Getz &Spetalnich, 1992).

The classroom is jointly administered by the Computer Center and the College of Arts and Science. Courses that meet regularly in the classroom are both upper- and lower-division classes in economics, mathematics, mechanical engineering, molecular biology, physics, psychology and sociology. All of these subjects seem to lend themselves to enhancement through the use of educational technology (Getz, & Spetalnich, 1992).

a. Benefits

The benefits of the project have been substantial. Over 90 percent of the students said they respond more favorably to instruction in the *Interdisciplinary Electronic Classroom* than to instruction in a traditional classroom. Two professors said they cover substantially more material, while maintaining or improving retention among their students, and one professor claimed that attendance is at an all-time high.

Vanderbilt is currently undertaking a five-year study to determine the lasting impact of learning in this type of classroom.

b. Success factors

The critical success factors that the faculty listed were: (1) vendor partnership (This was certainly necessary, considering the level of technology used.); (2) support from senior leadership within the school; and (3) support from the involved faculty members (Getz, & Spetalnich, 1992).

D. COMMON FACTORS

A common thread runs through all of the lists of critical factors for success of these projects. We will examine these common factors more closely.

Although listed as a critical item in only one of the projects, funding is still mentioned in all of the others. Inevitably, proper funding becomes an issue in any undertaking, and technology is no exception. Technology can be very expensive,

especially when it is applied to education. Those who want to bring technology into the classroom are going to have to include the necessary technology items in their annual budgets. It does not appear that institutions, in general, have a problem with investing money; however, not getting the promised return on investment is another story.

Support by senior leadership is another common factor in the success of all these projects. Without the support of superiors, a feeling that the project is unimportant quickly sets in. This, of course, leads everyone involved to waver in their commitment to the project. It is difficult to maintain enthusiasm for a project when it is clear to all involved that senior leaders don't care about it. Conversely, if senior leadership shows an interest and enthusiasm about a project, people want to become involved.

A third common factor is the faculty's belief that, by using technology, they would improve the learning of the students. For an educational technology program to succeed, teachers must be shown that the use of technology can improve the quality of what they are teaching. Analogous to this new level of quality through technology would be what Nicholas Negroponte (1995) says about High-Definition TV (HDTV): "There is no proof to support the premise that consumers prefer better picture quality rather than better content." Therefore, it is important to show that, with technology, we are not simply repackaging the same material, but are presenting a new and higher-quality product.

The last common determinant of success is the use of technology to address a *specific* and *identified* need, as opposed to technology simply for technology's sake. Only through the focused application of specific technologies can we maintain the clarity we need to the properly integrate educational technology into the classroom.

E. CONCLUSION

Kneckelbine's (1997) pointed article on the present problems with educational technology, cited in the beginning of this chapter, showed that the revolution that was

promised has not happened. In at least partial refutation of his thesis, this chapter has offered success stories and the critical success factors in each. If we can begin to approach the infusion of technology into education by applying the lessons learned from these cases, we will make large strides toward the magical transformation that educational technology promised.

An experiment will help determine how students will react to the infusion of technology into the classroom. This experiment will be described in the next chapter. The first part of the chapter will discuss examples of how two institutions are reacting to the use of presentation technology. In addition, it will present a guide to properly creating one of these presentations for personal use. The second half of the chapter will explain the experiment itself and discuss the reasons for doing the experiment and how the instructor will administer it.

IV. PRESENTATION & EXPERIMENT METHODOLOGY

In the second chapter, an article that summarized the lack of success of educational technology was discussed. The article gave specific examples of how large investments in ed tech have failed to bring about the revolution in learning that was initially promised. Then, in defense of ed tech, the chapter looked at four case studies in which the infusion of ed tech into the curriculum clearly showed its ability to increase the students' level of learning.

This chapter will examine some examples of how other institutions are implementing the same types of technologies that could be used to conduct our experiment. In the second half of the chapter, the goals and methodology of the experiment will be described.

A. HOW OTHER INSTITUTIONS HAVE INCORPORATED ADVANCED PRESENTATION TECHNOLOGY

Some examples of how presentations have been improved by the use of technology can be seen by the comments given in a case study from the Morton school district in Illinois. The instructors agreed that the use of projectors allowed students to see footage of materials and lessons in a new and different way, instead of the less descriptive, traditional two- dimensional displays on the chalkboard (Syllabus, January 1998, p.40).

Michigan State University (MSU) also incorporated projection tools into its classrooms. MSU's project began three years ago, when the university made a technology promise to its students: an intensive, quality-based technological experience from the beginning to the end of their college careers. A part of keeping this promise was the purchase of nearly 100 projectors for material presentation. Dr. Cecil Mackey, a professor of economics at the university, uses a projector to illustrate dynamic concepts

instead of relying on static graphs and pictures. During each lecture, he says he "transports the students on a journey to sites illustrating a particular lesson." According to Mackey, "the older, traditional methods of overhead transparencies and chalkboards are too static to fully appreciate the ever changing world of economics." He sees the student/instructor relationship changing because of technology. "The teacher used to control most of the information. Now, most of the information that the teacher has is readily available to students with the click of a mouse. . . . [B]y using technology together, the students become collaborators." (Syllabus, January 1998. p.40).

It would seem that the use of these technologies has generated a great deal of enthusiasm from the teaching community. However, how to properly use these new tools is a common concern, one that can be addressed by following some simple guidelines offered in an article by D.Adams and C.Blauer (Syllabus. February 1998, pp.18-22). Even educators who are new to the use of technology still have a background in effectively delivering information. Planning a multimedia presentation is not altogether different from planning one using traditional methods. All that changes is the medium, not the message. The outcome of the presentation should be the primary concern, and one should take into account the best way to present this information to a particular group in a particular setting.

B. PLANNING A MULTIMEDIA PRESENTATION

1. Keep it Simple

The first step is to ask ourselves whether our presentation will be linear--that is, one that progresses slide by slide--or multi-dimensional, which allows the presenter to detour into new topics or explore material more deeply as the situation warrants.

Next will be the selection of a presentation software. Here, it is best to stay within the comfort zone of the presenter. One product, Hyperstudio, is well known in the

education community for its ease of use and its complete graphics backgrounds, clip-art and sound effects. Mainstream presentation software, such as Powerpoint, Lotus Freelance Graphics or Harvard Graphics, are powerful tools that also can create a very refined presentation. In addition, these software packages also allow instructors to deviate from the prepared templates to create a presentation based on their visual preferences (Syllabus, January 1998, p. 40).

Educators advise students against cluttering their papers with flowery language and impressive words. The ability to clearly and simply demonstrate their understanding of the subject is substantially more important than the use of superficial elements. This same advice could be heeded when designing a multi-media presentation.

Keeping it simple is the best approach. Special fonts, graphics and colors should be used sparingly, and only where they provide an effective accent. Slides can't possibly contain every aspect of a presentation, and it's important to remember that the presenter is still the most important part of any presentation. Anything that detracts from the presenter detracts from the key point of delivery (Bankerd, 1997).

2. Proper Use of Fonts

Type can be both graphical and textual, and although choosing the proper font, style and size would seem to be a trivial matter, fonts have a significant conscious and subconscious effect on the audience. Typefaces can project feelings from imposing to casual and authoritative to informal. The key here is to select a font that is appropriate for the audience and the message (Bankard, 1997).

A good rule to follow for presentations that will be displayed through a projector is to use a sans serif font such as Helvetica or Arial. Serif fonts--Times and Palatino, for example--have softer edges that can become blurred when projected onto a large screen. Another issue is size. There are 72 points in an inch, and it is best to avoid using any

font smaller than 24 points. This allows easy reading of the slide even by people in the back row.

Some additional tips are: (1) Clearly title each screen using 35- to 45-point font; (2) Use no more than three fonts in any presentation; (3) Use color and italics sparingly; because italicized fonts can be difficult to read and are intended to make an audience pause, do not overuse them; (4) Keep running text to a minimum, using only six to eight words per line; and (5) use landscape vice portrait page layout since it is easier to fit longer lines (Bankerd, 1997).

3. Notes for the Audience

The second item to consider is what informative notes to give the audience so they can follow along, and how to distribute them. Powerpoint, by Microsoft, allows great flexibility in this regard in that it can print handouts that contain between one and six of your slides. Powerpoint can also combine slides with text to create speaker notes. In a society becoming less and less reliant on paper, students also appreciate having a diskette containing the presentation file for later viewing, if necessary. This, however, would require the audience to use the same software as the instructor. A better way might be to post the slides on the World Wide Web for people to view and print if they desire.

Certainly, one of the most important things to remember with any presentation is to have a backup plan. This would include extra cables, video adapters, or whatever else might be needed. Also, it's a good idea to carry hard copies of the presentation in case the projection device fails; this way, an instructor can resort to the more traditional lecture method with overhead transparencies.

Although multimedia presentations have a flair and flexibility that will better engage the audience, the focus must always remain on the message and not the medium (Syllabus, Jan 98. p.40).

C. PLANNING THE EXPERIMENT

It was with these ideas in mind that we created our experiment. By trying to adhere to the basic rules described above, we have tried to create a presentation that is more engaging than traditional methods, but not to the point of distraction, and that will create a feeling of greater participation in the student.

1. The Aim of the Experiment

With this experiment, we are trying to determine two things: (1) how, through the use of technology, we can enhance the students' learning process. In other words, does using technology make the learning process more enjoyable and thereby increase the level of learning for the students? (2) how we can encourage instructors to accept these technologies and increase their desire to implement them. In previous chapters, we have seen how educational technology has sometimes been touted as the solution to increased learning that we have all been looking for. We know, however, that this has not always been the case. For every success story there are many more projects that fail.

This experiment was conceived with the intention of doing something that is not widely used, as yet, in the application of educational technology. The aim was to bring the students into the design loop to help them learn the material more deeply and also retain it longer by being more of a participant in the process. After all, the students are the reason that we implement these technologies in the first place. In order to achieve these objectives, however, it is necessary to find out what the students like and dislike about technology into the classroom. This is accomplished through interviews, whenever possible, and through a survey the students and the instructor complete immediately following the experiment.

2. Reasons for Using Presentation Software

Currently, at the Naval Postgraduate School, most instructors use the traditional lecture method. This involves using blackboards to present the material and the occasional use of overhead transparencies to display diagrams or special material. Using these traditional methods has a number of disadvantages when compared to the use of presentation software. For example, if a student has a question during a lecture about a concept that has already been discussed, those blackboard notes have most likely been erased. The instructor must now take time out of the class period to completely rewrite the applicable information and begin to answer the student's question. Because this is time-consuming and tedious, the instructor often tries to give a verbal explanation rather that rewrite or redraw the information. This might be acceptable for some subjects, but if the subject were, for instance, mathematics, the applicable equations must be rewritten to answer the student's question. However, with the use of some presentation software, the instructor would merely have to hit the back arrow key on the computer keyboard to return to the applicable slide. Not only does this save time, but it also ensures that all the applicable material is displayed; relying on memory cannot offer the same guarantee.

Another advantage of putting the instructor's lecture material on presentation software is that it is convertible to Hypertext Markup Language (HTML), the language of the internet. Most presentation and word processing programs will save information to this format, and the lecture is then ready to be imported into a file server for access from the World Wide Web (WWW). This would be valuable to students and instructors alike. If students have trouble understanding a concept while rereading their notes, they can easily access the original slides for clarification instead of immediately going to the instructor. This saves time for both the student--who often has to wait for office hours--and the instructor, who normally has to arrange a meeting. Access to the WWW also makes it easy for students to check their notes for accuracy.

The information an instructor wishes to present no longer needs to be confined to what they can write into their notes. For example, in the middle of the presentation, the instructor can create a hyper-link to launch a web-browser and take students to a WWW address where amplifying subject material can be found. This could be a company's home page or a Quick Time movie or the audio portion of an interview with a key figure. All of these resources help increase the students' understanding of the material.

An additional advantage of using presentation software over plain transparencies is the ability to create a more interesting background on which to display the material. Presenting information in a more colorful manner can create a more engaging medium from which to learn. To this end, we have each slide in our experiment transitioning from one to the next in a random fashion in order to prevent a boring pattern from developing. Sounds were also added into each slide transition to increase the feeling of freshness.

D. RUNNING THE EXPERIMENT

The file containing the presentation material resides in a computer that is located in another room, but is connected to the school's local area network (LAN). This was done to simulate the concept of instructors creating and saving a presentation on their office computer, and then using a classroom computer to remotely log into their office computer and access the file. Doing this decreases the number of items that instructors must bring to class. No longer will they have to carry overhead presentation slides along with their class notes. Ideally, they would not even have to carry class notes these could all be placed on the computer and accessed from the classroom. Imagine the ease of having to bring only the textbook to class. (It may be possible someday to put the

contents of textbooks into the electronic format, but due to complicated copyright issues, this may not happen for many years.) In the end, the goal is to allow instructors to put all the information they need to give their lectures into a storage network that they can access through the school's computer network.

The material presented in our experiment will be viewed on a 27-inch big screen television monitor placed in the front of the classroom. It would also possible to use a three-tubed RGB projector to display the image onto a larger screen, like the one that is normally used to view items from an overhead projector. The students will be given an opportunity to say which they would prefer to view.

The instructor will control the presentation via a wireless keyboard with a built-in mouse that operates in the infrared spectrum (line-of-sight). This keyboard incorporates many single-button shortcuts to control the presentation, including a button that launches the web browser, close an application or close a function window and a button that launches the CD-ROM audio software. This wireless keyboard will allow the instructor to move throughout the room while lecturing, if so desired, while still maintaining the ability to control the computer equipment. In the future, keyboards that operate using radio frequencies should become available. These will increase instructors' freedom even further since they will not be limited to line of sight. It should also be noted that it may be necessary for the keyboards to incorporate some type of spread-spectrum frequency-hopping technology so as not to interfere with a neighboring presenter.

After completing the lesson that incorporated our experiment, the instructor and students will complete a survey. In addition, a control group consisting of another section of the same class that had the same lesson presented to them in the traditional manner, .

E. CONLUSION

This chapter examined technologies specific to the presentation of classroom material and gave a blueprint for constructing such a presentation. In addition, the chapter described the experiment and listed the issues is tried to resolve.

The next chapter will list the questions asked in the survey given to students and instructor immediately following the experiment. It also will summarize and analyze the answers gathered from the survey.

V. SURVEY RESULTS

This chapter will present the questions on the post-experiment survey; the answers will be quoted, when appropriate, and analyzed.

A. CONTENTS OF THE SURVEY

The survey is broken up into three different sections: big picture, technology specific, and student specific. The first two questions, which were put under the *big picture* category, were designed to stimulate the students' thinking about possible education applications of technologies of the future. They were instructed to let their imagination be their guide (e.g., would they like the incorporation of Virtual Reality learning tools or some other technology that, while not yet necessarily mature, would benefit the learning process).

The second section of the survey came under the heading of *technology specific* and included questions three through seven. This section centered around the students' feelings about specific technologies that they are used to seeing in presentations in the case of the control group, and the technology that they had just seen in the case of the technology group. The questions also deal with how the students feel about the infusion of technology into the classroom. Do they like or dislike it and why?

The third, and final, section of the survey was under the heading of *student specific* and addressed the last four questions. The students were asked about what they would like to see integrated into the classroom for *their* use and what types of services they would like to see made available to them in terms of technology.

Because the control group did not have the benefit of seeing the presentation delivered via Microsoft Powerpoint, some questions of the survey had to be modified in

order to make sense. The modifications were minor, and where the questions are different, both will be listed.

B. SURVEY QUESTIONS AND RESPONSES

Listed below are the questions and some of the responses given by the students, followed by an analysis of their responses.

1. Section One: Big Picture

a. Control Group Responses

1. Do you like the level of technology that you saw today for the presentation of material or would you prefer a higher level? Why?

In a class of 27 students, 61.5 percent replied that they would prefer a higher level of technology for the presentation of the class material, 37 percent said that the level of technology was sufficient, and one student abstained from answering. These results in the control group clearly demonstrate that the majority of students want the types of technology that they are accustomed to using for other purposes to be integrated into their learning environment. The following quotes from the student surveys illustrate this point. "The use of colors and diagrams would be more exciting and help improve learning." "Presentation could be better if Powerpoint was used." "Higher level. The standard is rising and world class organizations rise to meet it."

Students who thought that the level was sufficient for this presentation also commented that they were not against the inclusion of technology, only that, for the lecture presented, the level was sufficient.

b. Technology Group Responses

1. What kinds of technology do you think enhance the learning experience? Explain.

The technology group was told not to answer this question with respect to the presentation they just saw; rather, they, too, should let their imaginations be their guide. All replied that technology would be a benefit to the students. Their comments include: "Multi-media presentations add variety to the presentation." "Picture and sound multimedia technology make the learning experience more interesting." "Computer modeling--you can see different results from different variables very quickly." "Implementing interactive technology would be beneficial."

None of the students commented that the use of technology made learning more difficult or would not be beneficial to the learning experience. Their comments clearly indicate that students are drawn to the use of technology and feel that its inclusion in the classroom would benefit their learning.

c. Control and Technology Group

2. What about the use of technology in the classroom do you not like or think adds no value to learning? Why?

The comments by both sections of this class, interestingly, were very similar when it came to describing what parts of technology they felt were either distracting or of no added value to the learning experience. Nine students out of the 47 polled said that they disliked the use of too many "bells and whistles" just to keep their attention. Their comments include: "can get wrapped up in gee whiz rather than the material. Must keep it focused." These feelings might be summarized by one other student's comment that he doesn't like technology in the classroom "when we are only automating a manual task (e.g., turning a page) and don't add any content."

Clearly, the underlying theme is one of message, not messenger. They felt distracted by the sound effects, and one said that he thought the sound effects were "too childish."

The other common thread in the answers to this question was the students' frustration "when the instructor can't operate the technology." The students did not like

their time being wasted while the instructor tried to figure out how to use a particular piece of equipment.

2. Section Two:Technology Specific

Questions three through seven asked the students to comment on the specific examples of technology that they had just witnessed. In the case of questions three and four, the control group was asked to describe why they thought they would like or not like to have seen the presentation given via some type of presentation software. The students in the technology group were asked to express their opinions on what they liked and disliked about having their lecture presented in this medium.

a. Control Group

3. What do you like about the use of technology in the presentation of material over older methods of presentation (e.g. blackboards, overhead transparencies, etc.)?

Six of the 27 students said that they felt that the use of a presentation software to deliver the material would be "more interesting and easier to pay attention" to. Three liked the use of presentation software for its flexibility and simplicity, and five others said "a picture tells a thousand words and therefore the message delivery is enhanced." Of those students remaining, one said that Powerpoint "looks like quality," and another said presentation software is "visually stimulating and an interesting alternative to the same old boring blackboard lecture."

From these descriptions, it can be concluded that, even though they had not seen the material presented via presentation software, they wish they had.

b. Technology group

3. What did you like about the use of technology in the presentation you saw today over the traditional lecture method of presentation? (e.g. blackboards, overhead transparencies, etc.)

Of the group who saw the presentation via software and a big screen television, eight out of 20 said they liked the presentation because it had a "clearer picture" and was "more colorful and easier to read than cryptic blackboard notes." Two other comments worthy of mention were: "material is organized and the instructor wasn't writing with their back to the class while they presented the material and that handouts allowed us to focus on the discussion without taking notes." And "the instructor has to interact less with technology [versus the blackboard] so they can focus on delivering the message."

These last two comments are particularly enlightening because they illustrate how the use of technology can increase the instructor's interaction with the class to a level that is unattainable without the use of it.

b. Control Group

4. What do you not like about the use of technology in the presentation of material over older methods of presentation (e.g., blackboards, overhead transparencies, etc.)?

By far, the number one dislike about the use of educational technology was "often times the lack of dependability detracts from the learning experience." This sentiment was echoed by nine of the 27 students. Unfortunately, technology in general has not lived up to its potential reliability. This is true of computer-based systems as a whole, not just educational technology. Many of the problems encountered, however, are easily solved when the instructors are given the training necessary to operate the equipment. All too often, because of funding issues, instructors are left to their own devices to learn new educational technology products or new technology, in general, that may have a classroom use.

c. Technology Group

4. What do you dislike about the use of technology in today's presentation? (e.g., blackboards, overhead transparencies, etc.)?

The responses from the technology group to this question reiterated that they feel the use of excessive backgrounds in the slides are a distraction. Seven of the students again stated that too many sounds used in the transitions between slides was distracting. The belief that it is still "the message and not the messenger" is what is important was also mentioned.

5. Do you feel the use of excessive background graphics and sounds become a source of distraction from the material? does it help you maintain a feeling of involvement?

Thirty-seven out of 47 students surveyed said they felt distracted by the use of excessive background graphics and/or sounds. However, those students who replied with more than a yes or no answer said "certain sounds could be used to alert the student to key points." Another responded that it "depends on the subject being presented. If the lecture is informal, some sound effects would be ok, but in a formal lecture they would hurt." Another key point mentioned by the students was that "moderation is the key."

This question was included on the survey because of the many possible background graphics available in Microsoft Powerpoint. Most of these graphics are very busy, and it was useful to know if these busy graphics would become a distraction and make it more difficult for the students to read the slides. These responses make it clear that, indeed, busy backgrounds detract from the learning experience and, as one student wrote, "[they] verge on the unprofessional".

6. Do you think you would like seeing World Wide Web links used in a presentation? Do you think it would enhance the understanding of the of the material by showing it in a different light?

In the presentation that was given to the technology group, a World Wide Web link was embedded into the Powerpoint presentation. This link took the students to the WWW page of a company they were discussing in the lecture. The web page had documentation in it that directly reinforced the points the instructor was making about the company. 28 of the students replied that they liked the use of the WWW to access additional information, and 11 said that they did not feel it enhanced the learning experience. Those students in favor of WWW use also said "access would have to be fast." In other words, the web browser software and the speed of the connection to the Internet would have to be sufficiently fast to avoid breaking up the rhythm of the lecture. Of those students opposed to its use, one stated that "I'm very wary of the information on the World Wide Web--the authenticity of the information is not always known." This suggests that the use of the WWW should be restricted to sites that are known to provide quality and verifiable information (e.g., a major newspaper's online web site) in certain cases.

7. Do you like to view presentations on a big screen television monitor or would you prefer a larger image?(e.g., provided by a proxima type projector)

The results of this question were somewhat surprising. The expectation was that the students would naturally gravitate towards that larger format. This was not the case for the technology group. They were split evenly, with nine voting for a larger projection screen and nine for a big screen TV. Those who wanted a larger projection screen to be used made blanket comments like "bigger is better," while those who preferred the big screen TV explained that they preferred the clarity of a big screen TV over the sometimes blurry image of a projection screen. One student wrote: "Big screen

TV is fine. It doesn't take away from the instructor's presence like a projection screen would."

In the control group, the results were completely opposite. 25 students out of 28 voted for the large projection screen instead of the big screen TV. This may be due to the fact they the control group had not been exposed to the clarity with which slides can be viewed on a big screen TV. They are used to having black and white overhead slides displayed on a large projection screen, and the reduced clarity of this system might not become apparent to them until they have seen the big screen TV picture.

3. Section Three: Student Specific

The following questions were targeted to the desires of individual students. The idea was to give the students an opportunity to write out a wish list of technologies that they would either like to see become available in each classroom or would like to have provided for their individual use.

> *8. What items of technology would you like to see integrated into the classroom for student use? (e.g., laptops, web access, VCR, RGB projection system).*

All of the students voted for one or more of the above technologies to be put into use at the Naval Postgraduate School. The number one request was for the issuance of laptop computers to each student. Twenty-one students voted for this and had this to say about the lack of support the school is providing in this area: "Laptops should be commonplace at NPS" and "Many graduate schools issue laptops--we [NPS] have a long way to go." As portable communication devices continue to gain popularity, issuance of laptops to incoming students or the opportunity to buy a laptop computer at a significantly reduced price should most definitely become a top priority. Access to the World Wide Web and to a VCR tied for second place with 16 votes, and an RGB projection system received 13 votes.

One student made the observation that each of "these technologies have a learning curve. For some students, it may be counterproductive." The installation of technology without the necessary training and support to use it is in some cases worse than using no technology at all. If laptop computers, for example, are issued, a decision must be made about who will provide the technical and hardware support necessary for these devices.

9. Would you prefer to sit at an individual / more ergonomically designed desk, or do you prefer the bench type desks that are currently used? Does it matter? and if so, why?

Not surprisingly, the majority of students [23] said they would prefer to sit at an ergonomically designed desk and, more specifically, more ergonomic seats. Of the 23 that voted for individual desks, seven specifically mentioned the need for more ergonomic seating. The student comments include: "This is a small school; providing individual, ergonomic seating is something that could be done, and it sets a professional, concerned tone." Another said: "Ergonomics is important. If I'm comfortable, I can concentrate better."

Of the students who preferred the bench type seating now used at the school, they all mentioned how they liked having the space available in bench type seating to spread out their belongings. Also, they liked being able to easily interact with their neighbor in bench type seats. This level of interaction, if individual desks were adopted, could be maintained by allowing enough room between desks for students to move their chairs together for group discussions.

10. If power outlets and network jacks were available for use with laptop computers, for example, would you use them?

Thirty students said that if laptop computers were available, they would use these outlets and network jacks. One possible problem cited by a student was the idea that

"keyboard noise might be distracting" if laptop computers were used during a lecture. This is a valid point that may need to be handled on a case-by-case basis (i.e., whether or not the instructor or other students would find them a distraction].

11. If the professor does use some type of presentation software, would you like access to the slides via the web, for example? (e.g., accessible on the instructor's WWW site.)

Thirty-six students of 48 said that they would want access to the instructor's presentation. One student noted: "If I could get my notes elsewhere, I could spend more time paying attention" to the discussion.

4. Instructor's Questions

1. As the instructor, do you feel you need more training in the use of technology in the classroom and training on specific software? What software applications would you prefer?

The instructor who presented this lecture felt that instructors who wished to use these types of technology in their classrooms would need training, specifically in the proper way to create these presentations with a software package and how to access these files from the classroom environment.

2. As the instructor, would you like to see a computer for your use in each classroom? Would you like the capability to run multiple operating systems? (e.g., MacOS, Windows, UNIX)

"Yes, absolutely" was this instructor's response. Offering instructors a choice of operating systems from which to run their presentations allows them to remain in an environment where they feel comfortable and have proficiency in the use of the applicable software. This also allows instructors to use the software items, regardless of operating system, that help them to be the most creative and effective instructors they can be.

3. As the instructor, how much set-up time do you need to configure your current presentation system?

The instructor felt he would need about 4-5 minutes to get the slide projector ready. This means that the instructor would have to use ten percent of the available class time, for a standard 50-minute class period, just to get ready to begin. By using the presentation system that was used in the experiment, this time could be halved. All that would be required of the instructor would be to launch the appropriate presentation software application and then load the specific file. All this could be done in two to three minutes, at most.

4. As the instructor, do you feel that the application of presentation software and technology has increased your students' interest in and/or attention to the material being presented? How?

The instructor responded that, "I think it impresses people because it brings concepts to life." Presentation technology allows instructors to display information to their students in entirely new and fascinating ways, whether through the use of professional- looking bulleted slides or the playing of a three-dimension program to illustrate a physical concept. The possibilities are endless.

C. CONCLUSIONS

This chapter has listed and analyzed the survey responses given by both the control group and the technology group. The survey was broken down into three sections: big picture, technology specific, and student specific. In the first section, the students were asked to describe their general feelings about the infusion of educational technology into the classroom. They were asked to list their likes and dislikes about the technologies being used and what technologies they think might improve the learning environment. In the second section, students were asked to comment on the

technologies they had seen, in the case of the technology group, or would like to see, in the case of the control group. Finally, in the third section, students were asked to list specific technologies that they would like to see implemented for their own use--laptop computers, for example. Throughout the section of the chapter dealing with the survey, additional analysis was provided to better illuminate the students' answers and to try and define some conclusions that could be reached from the their responses. These conclusions include: (1) the idea that the message and not the messenger is still the most important item; and (2) the students liked the professionalism of the layout in the Powerpoint slides and the added flexibility that using them provides the instructor. In addition, students also said they would like additional funding to support the purchase of laptop computers for their use and to support the necessary training, both for students and instructors, to learn to use these technologies effectively.

One common dislike among the students is the implementation of technology that added only fancy distracters and no content. For example, too many sounds used in the transition between slides in a Powerpoint presentation.

The next chapter, the conclusion of the paper, will summarize what has been discussed so far and offer additional comments on the possible future direction of educational technology.

VI. CONCLUSION

This study in advanced material presentation has validated a proof of concept. The beginning of the paper looked at where and how the use of educational technology began over 30 years ago. Since that time, educational technology has matured from simple number crunching applications run on enormous mainframe computers to sophisticated audio and visual learning programs run on desktop machines. Educational technology has become a mainstream market and now receives national level attention by Congress and the President in the form of new legislation designed to push educational technology from institutions of higher learning down to the grade school level.

The paper has also given examples of successes and failures in the implementation of these technologies. Examples have shown that there is a common thread among success stories. By remembering and exploiting these commonalities, we increase our chances of success with our own implementations of technology. By ignoring them, we doom our projects to almost certain failure. The benefits of these programs are clear: increased learning by the students and better teaching practices by the instructors.

Chapter III described examples of how some institutions had already responded to the types of technologies being tested in the experiment. Clearly, the reception has been very favorable. The experiment done in this paper has tried to validate the beliefs of the other institutions, as well as introduce a feedback loop from the students. The students' opinions are a valuable tool that is often overlooked. By tailoring the purchase of technologies to those that the students feel are of value, schools can save themselves tremendous amounts of money. Hopefully, schools will no longer invest in software programs or hardware technology that students have no interest in using.

In examining the students' responses to the survey questions, it was possible to determine how they felt about the infusion of educational technology into their classrooms and to determine why and what they felt were important. The experiment has shown that students, in this age of information technology, prefer to use some types of technology to aid them in the learning process. The students clearly preferred presentation software to black and white overhead transparencies and the blackboard, as used in the traditional lecture method. Students felt more involved when taught with these technologies and liked the increased flexibility that the technologies offer. Their comments, however, were also tempered with the notion that it is still the message, not the messenger, that is important. In other words, they were not in favor of the blanket use of educational technology, but of the proper application of it.

Another conclusion that came from the big picture portion of the survey was the frustration students feel when instructors are unable to properly operate or troubleshoot these technologies. This is a clear indication that instructors will need to be funded for training in the use of these technologies. All too often, because of budgetary constraints, instructors are left to fend for themselves in gaining this training. This practice is wrong and needs to be addressed. When students have to wait too long for the instructor to set up or troubleshoot the equipment, it not only wastes valuable class time, but it also gives that specific technology a "bad name" if it gets a reputation for being unreliable.

The students also felt that too many "bells and whistles" used in the presentation software detracted from the learning experience. They felt that the presentations should be presented in as clean a manner as possible, with only moderate use of sounds or busy background graphics.

The students also said they would like access to World Wide Web links embedded in the presentation only if it directly reinforced the topic the instructor was discussing. It was also clear that the students did have some doubts about the validity of

the information available on the WWW. For this reason, instructors should restrict their use of these embedded links to web pages that have reputations for providing quality information (e.g., web pages of national newspapers or a specific company's homepage).

When it came to how the students wished to view the material, most said they preferred the big screen television over a projection screen. The reason they cited was the better clarity with which slides and graphs can be displayed. The clarity of projection technology, while improving, has yet to reach the level of the large CRT screens.

In the student section of the survey, almost all said they would like to be issued laptop computers. As portable technologies continue to gain popularity and functionality, the common use of this type of technology is soon to be upon us. If an institution wants to be on the cutting edge of these trends, it should seriously look into ways to make portable technology available to students. The other desire the students expressed was to be provided with more ergonomic seating coupled with individual desks. One of the students echoed the feelings of all with the idea that when they were more comfortable they were better able to learn.

Educational technology, when applied correctly, has a great deal of potential for helping people learn. Before infusing any type of costly new technology into the classroom, students should be asked for their opinions. This type of feedback loop is all too often not used. One cannot just assume that because a particular new technology promises to make learning easier and faster, that it is true. Students may prefer the older method or find no added value in the new technology. This is especially true when dealing with educational software products, which must be tested and proven to help students learn before it is used in the classroom.

Few things are more frustrating than investing a lot of money and getting no return on your investment. The level of sophistication with which schools now buy educational technology is improving, but they still have a ways to go.

In addition to the conclusions above, some specific lessons that the Department of the Navy can take from this thesis include:

- Proper funding for the training of instructor's in these new technologies is necessary if any educational technology implementation is to be successful.
- Support for the implementation of educational technology from senior officers is required or the project will fail.
- Students like the infusion of educational technology into the classroom, so long as we remember that it is the message, and not the messenger that is most important.
- Leading educational institutions are rising to the challenge of integrating educational technology into the classroom. The Department of the Navy needs to embrace these technologies as well to remain on the cutting-edge.

REFERENCES

Adams, D. & Blauer, C. (1998). Presentation strategies. T.H.E. Journal. 25 (7). 18-22.

Alessi, S. M. & Trollip, S. R. (1991). Computer based instruction: Methods and development. New Jersey: Prentice-Hall.

Bankerd, K. (1997, November/December). How to optimize projection technology: Using fonts, graphics and color to maximize the effectiveness of your presentation. Syllabus. pp. 32-35.

Becker, H. (1994). Analysis of trends of school use of new information technology. University of California: Irvine.

Bosco, J. (1995). Schooling and learning in an information society. In Herdman, R. C. (Eds.). Future Visions. (pp. 25-56). Washington, D.C.: US Government Printing Office.

Croy, M. J. (1992). CAI to enhance human interaction in learning: Deductive proof construction. In Boettcher, J.V. (Ed.). 101 Success stories of information technology in higher education: The Joe Wyatt challenge. (pp. 284-289). New York: McGraw-Hill.

Glennan, T. K. & Melmed, A. (1996). Fostering the use of technology: Elements of a national strategy. Washington, D.C.: RAND.

Keltner, B. & Ross, R. L. (1996). The cost of school based educational technology programs. Washington, D.C.: RAND.

Kneckelbine, S. (1997, September). We must aim higher. Technology and Learning. p. 71.

MacBrayne, P. (1992). community college of Maine: a state wide associate degree program. In Boettcher, J.V. (Ed.). 101 Success stories of information technology in higher education: The Joe Wyatt challenge. (pp. 53-57). New York: McGraw-Hill.

Negroponte, N. (1995). Being digital. New York : Vintage Books.

Office of Technology Assessment. (1995). Teachers and technology: Making the connection. Washington, D.C.: Congress of the United States.

Riel, M. (1995). Schooling and learning in an information society. In Herdman, R. C. (Eds.). Future Visions. (pp. 25-56). Washington, D.C.: US Government Printing Office.

Sharp projectors illustrate the big picture. (1998, January). Syllabus. p. 40.

Sharp projectors replace chalkboards. (1998, January). Syllabus. p. 40.

Spetalnich, T. & Getz, M. (1992). Interdisciplinary electronic classroom. In Boettcher, J.V. (Ed.). 101 Success stories of information technology in higher education: The Joe Wyatt challenge. (pp. 496-500). New York: McGraw-Hill.

Stropes, S.S. (1992). Center of emphasis. In Boettcher, J.V. (Ed.). 101 Success stories of information technology in higher education: The Joe Wyatt challenge. (pp. 47-52). New York: McGraw-Hill.

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center 2
   8725 John J. Kingman Rd., Ste 0944
   Ft. Belvoir, VA 22060.6218

2. Dudley Knox Library 2
   Naval Postgraduate School
   411 Dyer Rd.
   Monterey, CA 93943.5101